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PHYSICAL SCIENCES

VISTAS

PERSPECTIVES ON EXCELLENCE IN SCIENCE, TECHNOLOGY, AND ENGINEERING | ISSUE 2 2021

INSIDE

Los Alamos
NATIONAL LABORATORY

CONTENTS

On the cover: An illustration showing Miles Beaux adjusting the first-of-its kind scanning tunneling microscope for plutonium housed in an ultra-high vacuum system. Inset: Scanning tunneling spectra collected from a location within a 0.5 x 0.5 nm^2 area on an electropolished plutonium sample after its first sputter/anneal treatment. The surface's dynamically changing electronic structure is clearly apparent over 10 minutes after the first sputter treatment.

Inside cover: Amber Black uses a 6-kW laser in the Sigma Complex's laser lab as part of an effort to develop welds for the first laser welded hydrodynamic test object.

Physical Sciences Directorate

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FROM TONI'S DESK

Toni Taylor, Associate Laboratory Director for Physical Sciences

I am pleased to introduce the second 2021 issue of *Physical Sciences Vistas,* with a focus on "excellence in mission-focused science, technology, and engineering." Excellence in mission-focused ST&E within the Physical Sciences Directorate (ALDPS) spans a broad spectrum of accomplishments in nuclear physics and materials science that sustains and enhances LANL's science base.

In this issue, highlights of our contributions to mission-focused ST&E include descriptions of the following.

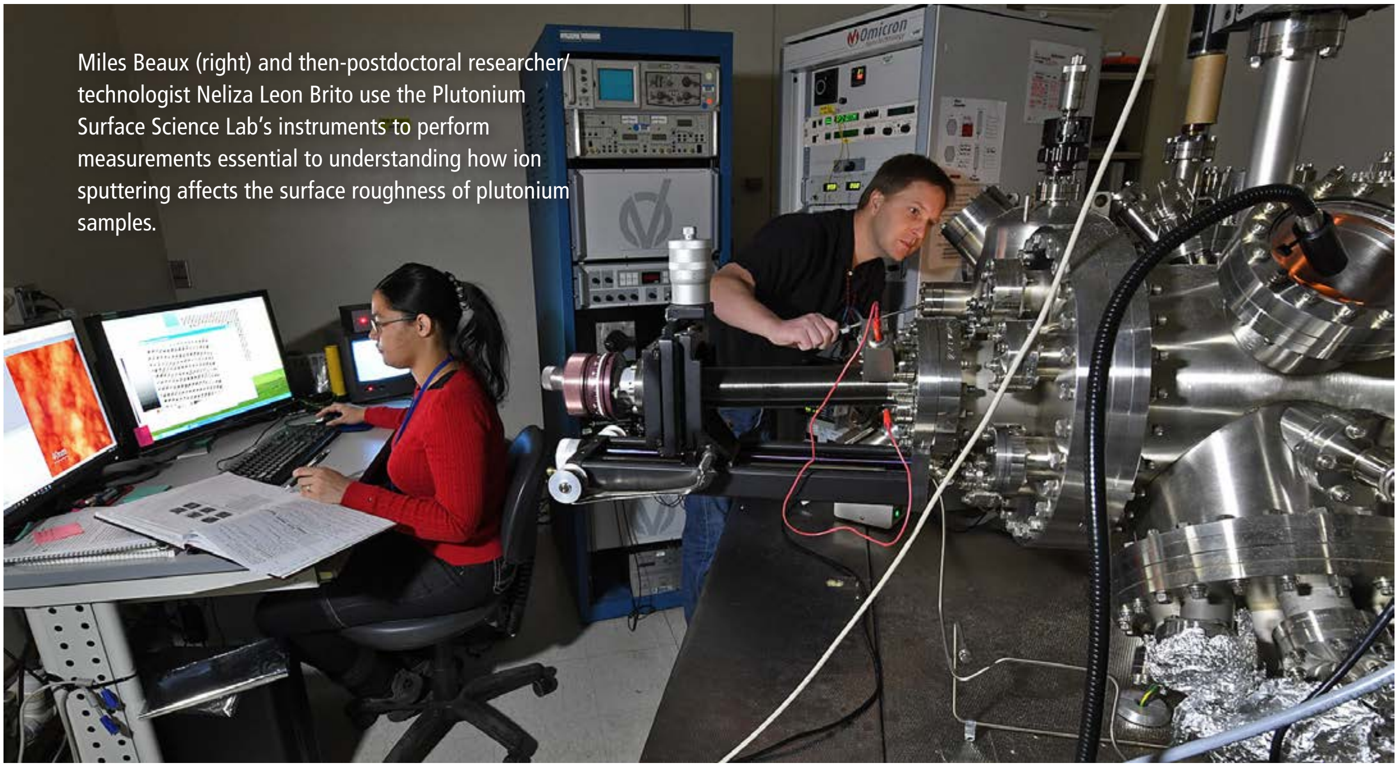
- Research using a LANL-developed, first-of-its-kind scanning tunneling microscope (STM) to investigate the role ion sputtering plays on the surface roughness of plutonium. This work by staff in Materials Science and Technology (MST) and Chemistry (C) divisions is part of an effort to develop samples of the quality needed for atomic resolution STM imaging of this complex element central to the Lab's national security mission.
- A series of integrated experiments, by members of Materials Physics and Applications Division (MPA) and Weapons Physics (ALDX) and Weapons Engineering (ALDW) directorates, demonstrating the viability of fuel cells as power sources for nuclear weapons applications. The work was a cornerstone to achieving a level 2 milestone in the Surety Technology Program.
- An introduction to materials scientist Rod McCabe, who through a Basic Energy Sciences project and his work in the Electron Microscopy Lab, seeks to connect how a material's structure influences its properties and its performance.
- The development of a high-density magnesium oxide ceramic substrate using a novel tape-casting formulation and process. The technology, with wide-ranging applications, was enabled by the advanced manufacturing and ceramic processing manufacturing capabilities in the Sigma Complex.
- A look at new directions in understanding the transport and breakup of reactive ejecta proposed by a team of LANL researchers and colleagues at Yale University and the Special Technologies Laboratory. The work leverages the Lab's expertise in modeling and simulation, materials characterization, and ejecta physics.

In support of excellence in community relations, ALDPS staff members are welcoming six students from across the country to their labs as part of the DOE SC Graduate Student Research Program. These high-achieving students are valued members of our early career workforce.

In an example of excellence in mission operations, we highlight how—through an asset management improvement project—the directorate is strategically maintaining facilities critical to mission success. Led by Evan Spence, the newly begun project is focusing on two pilot organizations, LANSCE and Sigma, and enlisting the expertise of their facility operations teams.

Finally, I am excited to announce here that the Laboratory has recently joined the nationwide American Physical Society's Inclusion, Diversity, and Equity Alliance (APS-IDEA). As Lab champion for this volunteer chapter, which was endorsed by Director Mason, I look forward to the suggestions for positive systemic change put forth by its members. The LANL team aims to develop a sustainable, long-term strategy for diversity and inclusion that is independent of individual efforts, and involves the efforts of the institution. As part of that initiative, ALDPS is hosting a series of brown bag discussions focused on diversity, inclusion, belonging, and equity. I invite you to attend and share your ideas for transforming our culture. Look for announcements on the next event in your inbox or on the ALDPS web page.

Toni



Miles Beaux (right) and then-postdoctoral researcher/technologist Neliza Leon Brito use the Plutonium Surface Science Lab's instruments to perform measurements essential to understanding how ion sputtering affects the surface roughness of plutonium samples.

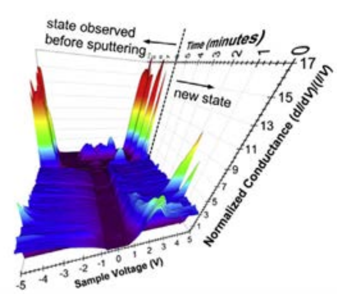
Role of ion sputtering examined in quest to develop atomic resolution images of plutonium

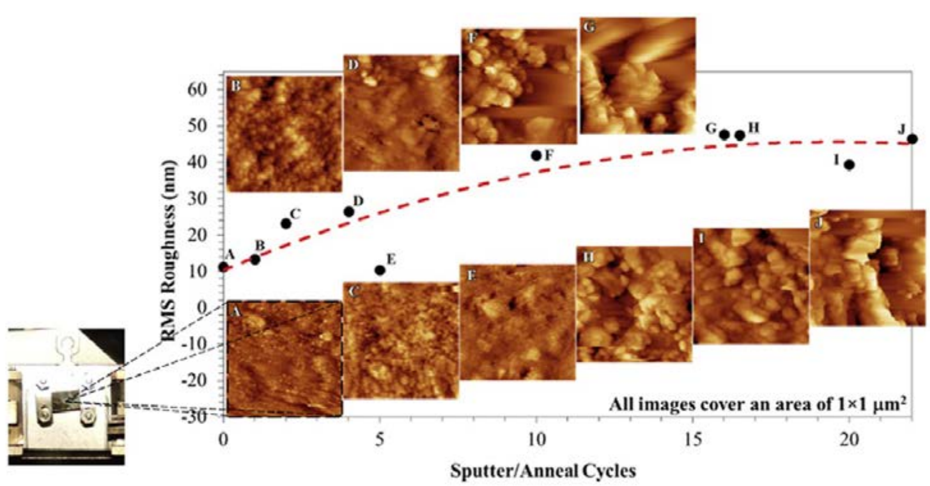
Actinide scientists broadly regard plutonium (Pu) as the most complex element in the periodic table. Its reactivity, radioactivity, and toxicity make plutonium intriguing—yet challenging—to analyze.

With the aim of characterizing Pu surfaces with high spatial resolution, Los Alamos developed a first-of-its-kind scanning tunneling microscopy (STM) capability for plutonium housed in an ultra-high vacuum (UHV) system. Despite the tool's ability to produce atomic resolution images of well-known standards, achieving such resolution for Pu sample surfaces has been prevented by the difficult challenge of producing a suitable surface.

Sputtering is a well-established method of preparing Pu surfaces under UHV conditions for analysis. However, no studies have addressed the effects of this method on the surface roughness of Pu. Although it is well known that sputtering of a sample surface can result in damage and roughening, when combined with annealing in certain materials under the right conditions, sputtering can result in atomically clean, smooth, and defect-free surfaces.

continued on next page ▶





A picture of the plutonium sample (right) is shown along with microscope images (far right) of the sample surface. The spectral graph (above) demonstrates the dynamically changing electronic structure of the plutonium surface over 10 minutes after the first sputter treatment.

Role of ion sputtering continued ...

Miles Beaux with the plutonium glovebox used to mount a sample used in this study.

As part of an effort to produce Pu surfaces of the quality needed for atomic resolution STM imaging, Los Alamos researchers investigated the effects of argon-ion sputtering and subsequent annealing on the surface roughness of Pu samples. According to Miles Beaux (Engineered Materials, MST-7), who led the effort to establish the capability, direct observation of the radioactive decay of a single atom using STM was proposed in 2003 by Alexander V. Balatsky and Jian-Xin Zhu (LA-UR-03-4350). “The establishment of a plutonium-capable STM is an opportunity to reach this objective,” he said.

The team’s research revealed that such sputtering/annealing cycles progressively increased the surface roughness of the Pu. Additionally, Auger and STM measurements revealed an initially unstable and dynamically changing surface that became increasingly stable as sputter/anneal cycles were applied. They noted that the stabilized surface region contained within the sputter crater was observed to be unchanged for up to 17 months after the final sputter anneal cycle.

“This was surprising since it was assumed that under UHV conditions, the material would revert back to its pretreated state,” Beaux said. ■

Get the details

Researchers: Miles Beaux, Igor Usov (Engineered Materials, MST-7); Stephen Joyce (Physical Chemistry and Applied Spectroscopy, C-PCS). **Reference:** “Effects of ion sputtering on plutonium surfaces,” *Journal of Nuclear Materials* 540, 152378 (2020). Samples were provided by Nuclear Materials Science (MST-16). **Mission connection:** The work supports the Lab’s Stockpile Stewardship mission area and the Materials for the Future science pillar. It was performed in the Plutonium Surface Science Laboratory, which is operated as a collaboration between MST-7 and MST-16. **Funding:** The work was funded by the Lab’s Science Campaign 1. **Technical contact:** Miles Beaux

MEET ROD McCABE

R&D Scientist, Materials Science in Radiation and Dynamics Extremes (MST-8)

Honing in on the details is important in Rod McCabe’s line of work. As a materials scientist he uses the tools and capabilities of the Los Alamos Electron Microscopy Laboratory (EML) to examine and distinguish the features of metal microstructures.

His results are aimed at connecting how a material’s microstructure influences its properties and performance under specific conditions. The work is part of the Lab’s goal to reliably predict a material’s performance over its lifetime and design properties that were previously unattainable.

As part of a Basic Energy Sciences-funded project focusing on hexagonal-close-packed metals, McCabe contributes to an effort aimed at better understanding how materials deform and ultimately fail.

The outcome of this project, which relies on a “close working relationship between modelers and experimentalists,” McCabe said, “will be better-informed models for the strength and failure of materials.” Such information “is essential for developing materials with improved properties,” he said—such as materials that are stronger, lighter, or more ductile.

The enthusiasm McCabe brings to linking diverse materials properties is also apparent in his role managing the EML, which connects him with researchers across the Laboratory.

According to McCabe, the most exciting aspect of this “is interacting with the users, learning about all of the various types of research at LANL that take advantage of electron microscopy, and helping users obtain the best data possible from our tools.” ■

Fuel cell technology **animates weapons science applications**

Los Alamos National Laboratory's mission is to solve national security challenges through scientific excellence. For nearly 50 years the Lab's Fuel Cell Program has focused on finding innovative and robust solutions to the nation's renewable energy challenges. Now technology and expertise developed in Materials Synthesis and Integrated Devices (MPA-11) as part of that effort is set to stimulate advances in the Lab's nuclear security mission.

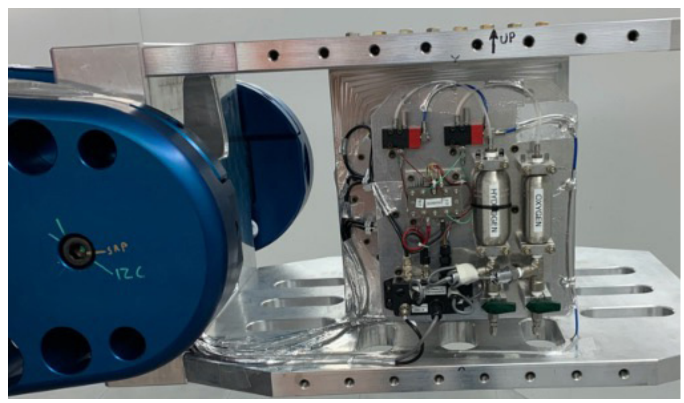
A recent series of integrated experiments subjected operating "SuperCell" fuel cell stacks to high g-forces and shock and vibration (S&V) environments relevant to current and future weapon systems. The SuperCell is of interest for certain power source applications because of particular features, including the ability to store the chemical reactants, hydrogen and oxygen, separately from the power producing unit, and in a form that never degrades.

Unlike typical fuel cell stacks that operate at low and regulated pressures, these stacks are designed to sit dormant for many years and then once valves are actuated, they are "supercharged" (hence their name) by the inrush of unregulated reactants directly from pressurized cylinders. Stored dormant in a freeze-proof configuration, the SuperCell is then jolted to life and rejuvenated by the high-pressure reactants and within seconds provides the necessary power.

Planning of the integrated experiments began as the Lab moved to a mission-essential operating status at the start of the COVID pandemic. This disruption in normal work routines complicated the development of a system capable of withstanding these challenging environments in order to interrogate the fuel cell itself. These included experiments to identify reactant valves capable of operating under high g-forces and designs that resulted in reliable reactant delivery.

In the experiments, the SuperCells powered electronics developed in the Detonator Science and Technology Group (Q-6) and integrated with an experimental design developed in the Delivery Environments and Stockpile Responsiveness programs. The package was subjected to 180 g-forces at the LANL centrifuge facility. The SuperCell system and Q-6 electronics performed flawlessly in the two most challenging orientations tested. Likewise, a separate SuperCell + Q-6 electronics unit reliably and repeatedly withstood a comprehensive suite of S&V environments to evaluate performance in launch, flight, and reentry. These results demonstrated the viability of fuel cells as power sources for nuclear weapons applications. They were a cornerstone to achieving TRL 4 for the technology and achieving a level 2 milestone in the Surety Technologies Program. ■

Pictured are some of the many contributors to the integrated centrifuge experiment that were on this day setting up the experimental package for the run in the first orientation. Left to right: Alex Cusick, Mahlon Wilson, Renita Walzel, Ricky Rodriguez-Molina, Ricky Uliano, Kalpak Dighe, Kirk Webber, Mike Archuleta, and Greg Weiss.



Pictured is the integrated experimental package mounted on the end of the centrifuge arm in the second orientation. The SuperCell level is directly facing the camera, immediately behind is the Q-6 electronics tier. These are hitching a ride on and obscuring the view of the main unit further back.

Get the details

Between the testing facilities and experimental logistics, dozens of individuals spanning MPA-11; Q-6; Test Engineering, E-14; Advanced Engineering Analysis, W-13; Technology Development, Q-18; Technology Applications, A-3; Engineering, Operations, and Physics, J-6; Engineering and Technology Maturation, ETM; and Weapons Physics Directorate, ALDX, were involved. Programmatically, this was a collaboration between the Stockpile Responsiveness, Delivery Environments, and Surety Technologies programs. Jon Rau (ALDX) was lead program manager for Surety Technologies; Antranik Siri-nosian (W-13) for Delivery Environments; and Steve Judd (ALDX) and Matt Tucker (Q-DO, now Office of National Security and International Studies) for Stockpile Responsiveness Program. **Technical contact** (fuel cells): Mahlon Wilson **Programmatic contact:** Jon Rau

High-performance **MgO ceramic substrate** using tape-casting technology

Magnesium oxide (MgO) has applications for high-temperature insulation due to several unique properties, including a high melting point (2852°C), a high thermal conductivity (~50 W/mK), and a high breakdown potential (8 MV/m). MgO also has been found to be a suitable substrate material for the processing of metals and high-quality Bi-2212-thick films due to its minimal reactivity and structural stability when exposed to the required processing conditions. However, due to MgO's tendency to form hydroxide, producing high-density MgO ceramics is extremely difficult.

LANL researchers and their collaborators recently developed a high-density MgO ceramic substrate produced by a novel tape-casting formulation and process that generated a uniform tape free of cracking. The excellent low dielectric constant and low-loss tangent of the developed MgO substrate will have a transformational impact to a wide range of applications including satellite, high-power microwave, microelectronic, optoelectronic, power modules, aerospace, and defense.

With its unique MgO processing expertise and tape-casting technology, the team has accomplished a major breakthrough in producing a high-quality MgO substrate with unsurpassed refractive index, as-fired surface finishing, and thermal properties. The technology was enabled by the Lab's expertise in advanced manufacturing and the ceramic processing manufacturing capabilities in the Sigma Complex.

Y_2O_3 and SiO_2 were used as the sintering aid for the pressureless sintering of the green tape. Figure 1 is an x-ray diffraction pattern that shows MgO is the main phase, while both Y_2O_3 and SiO_2 sintering aids react with MgO to form $MgY_4Si_3O_{13}$ as the second phase. A MgO substrate with 96.5% theoretical density was achieved by pressureless sintering at 1650°C for two hours. Figure 2 shows the surface roughness of the substrate and the inset photo shows the typical sintered substrate. The pressureless sintered substrate was further increased to a fully dense structure using hot-isostatic-pressing at 1650°C and 207 MPa in argon. Figure 3 shows the transparency of the hot isostatically pressed MgO substrate. Scanning electron microscopy and energy dispersive spectroscopic analysis on the hot isostatically pressed sample show that $MgY_4Si_3O_{13}$ is located at the MgO grain boundary and the sample has a fully dense structure. The refractive indices and extinction coefficient were measured on the hot isostatically pressed sample along with thermal properties and dielectric properties. Thermal diffusivity and heat capacity were measured to calculate the thermal conductivity. ■

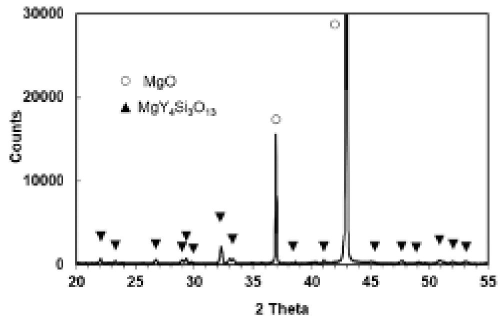


Figure 1: An x-ray diffraction pattern that shows MgO is the main phase, while both Y_2O_3 and SiO_2 sintering aids react with MgO to form $MgY_4Si_3O_{13}$ as the second phase.

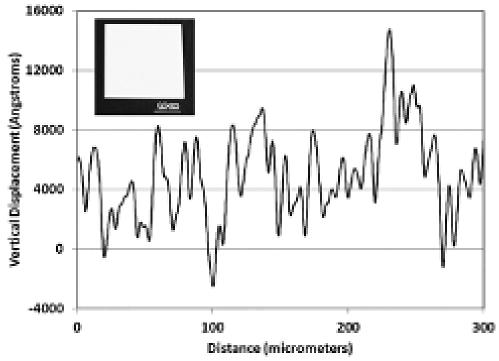


Figure 2: The surface roughness of the substrate and the inset photo shows the typical sintered substrate.

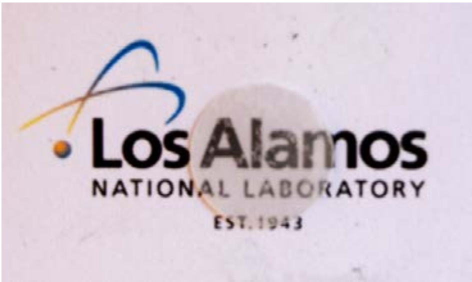


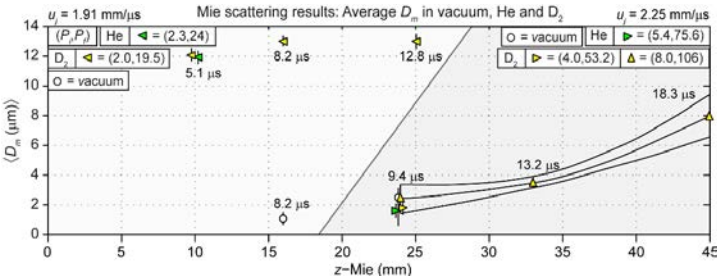
Figure 3: An image showing the transparency of the pressureless sintered substrate after hot isostatic pressing at 1650°C and 207 MPa in argon.

Get the details

This work is a joint development between Los Alamos, J. A. Woollam Corporation, and Sienna Technologies, Inc. **Researchers:** Chris Chen (Fabrication Manufacturing Science, Sigma-1); Timothy Baker (LANL); Ron Synowicki (J.A. Woollam Corp.); Eric Tegtmeier, Robert Forsyth (Finishing Manufacturing Science, Sigma-2); Ashley Bissell, Alex Orlowski (Sienna Technologies, Inc.); James Christopher (Sigma-1); Ender Savrun (Sienna Technologies, Inc.). **Reference:** "Tape casting and characterizations of MgO ceramics," *Journal of American Ceramics Society* (2020). **Mission connection:** The work supports LANL's Materials for the Future mission. **Funding:** This work was supported by the PIT Technology program (LANL Program Manager Francisca Rein Rocha). **Technical contact:** Chris Chen

Understanding the **transport and breakup** of reactive ejecta

In work appearing in a special issue of *Physica D*, W.T. Buttler (Applied and Fundamental Physics, P-2) and colleagues identify new directions of enquiry in ejecta physics, in particular the transport and breakup of reactive ejecta. Ejecta form as a spray of dense particles expelled from the back surface of metals into a vacuum or gas when the metal is subjected to strong shocks. Interest in ejecta centers on military and industrial applications, including the physics of fusion.



The size data to the left are solid cerium ejecta, and the size data in the shaded region show the exponentially increasing cerium diameters of initially liquid cerium ejecta as caused by reactive processes.

In their manuscript, which focuses on the transport and breakup of reactive and nonreactive liquid fragments (ejecta) in nonreactive and reactive gases, Buttler, et al., postulate that for ejecta transport there exists rapid, reactive breakup processes beyond the well-documented hydrodynamic breakup processes. They propose that reactive breakup processes lead to more mass coupling-to-shocked gases than is possible in hydrodynamic breakup of liquid fragments.

The hypothesis was studied with common shock-physics mass- and velocity-diagnostics combined with dynamic radiance- and ejecta-size measurements (infrared cameras and two-channel-fiber-based pyrometry, and Mie scattering techniques) on explosively driven ejecta experiments. On these experiments, they studied liquid tin and cerium ejecta (nonreactive and reactive ejecta) transporting vacuum, helium, and hydrogen gases (nonreactive and reactive gases) at high initial pressures. The results support the hypothesis.

Importantly, in contrast to the well-known hydrodynamic breakup of liquid fragments in which large diameter particles break up and stabilize at smaller diameters, the diameters of reactive ejecta transporting in reactive gases were seen to exponentially increase with time (see figure). The velocimetry and radiance temperature data on those experiments inferred that smaller particles of diameters <1-to 2 µm broke up rapidly. The researchers hypothesize that the reactive process proceeds as a CeH_2 or CeD_2 crust forms on the liquid Ce spray (droplets). The crust limits the reaction of the Ce + H_2 to the diffusion of H through the CeH_2. As the Ce reacts to form CeH_2, the exothermic reaction heats the CeH_2 crust and the liquid Ce core. Once the Ce core and CeH_2 reach the melt temperature of the CeH_2, $T_m(CeH_2)$, the diameter of the particles is then hydrodynamically unstable and the particles rapidly evaporate to leave behind larger diameter particles that have not yet heated to $T_m(CeH_2)$. This is an avenue being investigated.

The dynamic size data from the reactive and nonreactive transport experiments also reveal that the partition of ejecta mass that couples to the gas in which the ejecta transport cannot be described. This is important given that the fundamental interest in ejecta is knowing how much mass is coupled to the gas. However, the team's experimental results combined with Mie theory and the total mass-velocity distribution of the ejecta transporting in the gases suggest an approach to determine this "dark-mass," or the partition of ejecta mass below lower resolution limits of sizing diagnostics. They have also hypothesized new approaches to determine the temperatures of ejecta from these data, without knowing emissivity.

continued on next page ►

Get the details

Reference: "Understanding the transport and breakup of reactive ejecta," *Physica D* 415 132787 (2021). **Authors:** William T. Buttler (Applied and Fundamental Physics, P-2); Roland K. Schulze (Surveillance Oversight, W-9); John J. Charonko (P-2); Jason C. Cooley (Fabrication Manufacturing Science, Sigma-1); James E. Hammerberg (W-9); John D. Schwarzkopf (XTD Integrated Design and Assessment, XTD-IDA); Daniel G. Sheppard (Materials and Physical Data, XCP-5); Johnny J. Goett III (P-2); Michael Grover, Brandon M. La Lone (both Special Technologies Laboratory); Steven K. Lamoreaux (Yale University); Ruben Manzanares (Dynamic Imaging and Radiography, P-1); John I. Martinez (Engineering Materials, MST-7); Jonathan D. Regele (Continuum Models and Numerical Models, XCP-4); Martin M. Schauer (P-2); Derek W. Schmidt (MST-7); Gerald D. Stevens, William D. Turley, Ruben J. Valencia (all Special Technologies Laboratory). **Mission connection:** Work supports the Lab's Stockpile Stewardship mission and Nuclear and Particle Futures and Information Science and Technology science pillars. **Funding:** Work was funded by a Los Alamos Laboratory Directed Research and Development Direct Research project, Experimental Sciences Campaigns 1 and 2, and the Advanced Simulation and Computing Program for Physics and Engineering Models. **Technical contact:** W.T. Buttler

DOE graduate program **teams top students** with ALDPS researchers

Six students from across the country are coming to the Physical Sciences Directorate (ALDPS) for their research experience as part of a DOE graduate student program that prepares students for careers in science, technology, engineering, or math (STEM). They are part of a 52-strong cohort of students from 43 different universities sponsored to conduct research at 12 national laboratories.

"The DOE SC Graduate Student Research Program has a LANL track record of providing top-tier doctoral students who end up making meaningful contributions to both the mission of the Laboratory and their selected fields of scientific study," said Scott Robbins, LANL Student Programs manager. "The graduate student researchers are highly valued by Laboratory managers and mentors and many end up entering the DOE scientific enterprise as postdoctoral appointees and staff scientists."

The Office of Science Graduate Student Research (SCGSR) Program aims to prepare graduate students for STEM careers critically important to the DOE Office of Science mission by providing graduate thesis research opportunities through extended residency at DOE laboratories.

The research projects proposed by the new awardees demonstrate strong alignment with the priority mission areas of the DOE Office of Science that have a high need for workforce development. The DOE SCGSR Program plays an important role in sustaining a pipeline for highly skilled scientific and technological workforce development by providing new graduate research opportunities at DOE national laboratories. The SCGSR Program is sponsored and managed by the DOE Office of Science's Office of Workforce Development for Teachers and Scientists, in collaboration with the six Office of Science research programs and the DOE national laboratories/facilities.

Working with ALDPS scientists are the following students, their universities, and their subject areas.

Clay Barton, University of South Dakota, low energy nuclear physics, working with Ralph Massarczyk (Dynamic Imaging and Radiography, P-1)

Jared Brewington, University of Kentucky, low energy nuclear physics, working with Steven Clayton (Nuclear and Particle Physics and Applications, P-3)

Luis Martinez, University of Texas at El Paso, ultrafast materials and chemical sciences, working with Rohit Prasankumar (Center for Integrated Nanotechnologies, MPA-CINT)

Luke Mitchell McClintock, University of California, Davis, ultrafast materials and chemical sciences, working with Dmitry Yarotski (Thermonuclear Plasma Physics, P-4)

Alexandre Frederick Mills, University of New Mexico, experimental research in high energy physics, working with Steve Elliot (P-1)

Douglas Kim-Tak Wong, Indiana University Bloomington, low energy nuclear physics, working with Takeyasu Ito (P-3)

Understanding continued ...

These are two new avenues of ejecta physics that have heretofore not been studied: the rapid heating due to exothermic reactions of the transporting ejecta, as accompanied by the exponentially increasing diameters, and the hydrodynamic- and reactive-partitions of ejecta mass below the lower resolution limits of the sizing diagnostics—the dark mass. The theory of ejecta temperatures postulated is also to be explored and the researchers expect the temperature approach to inform the melt temperature of CeH_2, which is unknown.

The work leverages the Laboratory's expertise and capabilities in modeling and simulation, materials characterization, and ejecta physics. Buttler performed his research at the Special Technologies Laboratory, part of the Nevada-centered complex of facilities owned by the NNSA and which is a multi-mission support organization benefiting DOE stockpile stewardship, physical security, and nonproliferation organizations, as well as other programs associated with the Nevada National Security Site.

The special issue honors the career and contributions of British researcher David L. Young, a leader in the field of instability physics. Young (retired from AWE) "has done remarkable things in his career, and I had the great pleasure to spend much time with him and work with him," Buttler said.

Strategically **managing critical equipment** to ensure mission success

For more than half a century, the nation has relied on the Los Alamos Neutron Science Center (LANSCE) and the Sigma Complex for their contributions to our national security. The desire to maintain these facilities in peak operational condition through periods of equipment upgrade, overhaul, and obsolescence has led to availability and operational challenges. Enter asset management.

Asset management involves coordinating activities and plans required to mitigate asset-related risks over the life cycle of a given asset. The process is used to plan, optimize, execute, and track the needed maintenance activities with the associated priorities, skills, materials, tools, and information. The Physical Sciences Directorate (ALDPS) has launched an asset management improvement project to centralize, standardize, and improve upon Laboratory processes within two pilot organizations: LANSCE and Sigma, and the associated facility operations teams.

Over an initial period of 22 months, project teams will devote resources to address maintenance workflow, materials management, and engineering projects. The outcome of these projects will improve how maintenance workflow processes are managed and how spare parts inventories are stored and controlled, and will serve as the central database for all failure and work history. The project also expects to implement changes to preventive maintenance routines and how risk is identified, analyzed, and managed.

In addition to internal LANL support, ALDPS has engaged Eruditio, an asset management engineering firm headquartered in Charleston, South Carolina, to guide the project through the improvement process and augment Lab staff to accelerate the improvement plan. Eruditio has supported similar projects at the Spallation Neutron Source and Y-12 facilities in Oak Ridge, Tennessee.

> "Tackling the problem together creates new opportunities to collaborate and develop new capabilities."
>
> Asset Management Project Lead
> Evan Spence

"Tackling the problem together creates new opportunities to collaborate and develop new capabilities," said Evan Spence, project lead for the asset management improvement project. "By reducing duplicate efforts, focusing on a single management system solution, LANSCE, Sigma, and facility operations will free up resources and time to address the more immediate technical issues facing each organization."

The asset management initiative will also help align management systems to proactively secure funding over the life cycle of each facility. Within the project, an enterprise asset management system will be selected and deployed. "The focus in 2021 is to develop processes that will give stakeholders the confidence to continue to invest in the future of these flagship facilities," said Spence (ALDPS).

As the pilot program defines best practices and develops lessons learned, the project expects to expand the scope to include additional ALDPS assets. Periodic updates on the progress of the project–and its successes–will be provided over the coming months. ■

Get the details

Major highlights and contributors to the asset management project, to date, include the following. Everett Espinoza (Accelerator Operations, AOT-OPS) and Deepak Rai (Instrumentation and Controls, AOT-IC) supported the cataloging of more than 2000 assets during the LANSCE asset hierarchy event and over 800 inventory parts during the item master development. They also analyzed accelerator downtime data to identify common systems among failures. Steve Sherman (Accelerator Operations and Technology, AOT-DO) is a steering committee member and leader of the Workflow Management Team responsible for project team deliverables. Ted Keppner (Sigma Division, Sigma-DO) has coordinated tours, project activities, and data gathering while serving as the sole engineering project support from Sigma Division. Gary Hagermann (LANSCE Facility Operations, LANSCE-FO), who as a member of the steering committee, is a liaison between group leaders and LFO maintenance engineers. Fred Berl (Maintenance and Site Services, Work Control, MSS-WC), who as a member of the Workflow Management Focus Improvement Team (FIT), has provided valuable insight into the asset and maintenance management best practices within MSS. Matt Goodyear (Fabrication Manufacturing Science, Sigma-1) has made significant contributions to the Materials Management FIT. This is not an all-inclusive list and we look forward to highlighting additional efforts from project participants in the near future. **Technical contact:** Evan Spence

Asset Management Project

Integrating best practices at LANSCE, SIGMA and Facilities Operations

Our Charter

22 Months

- Systemize our ability to mitigate risks impacting Asset Availability
- Standardize maintenance and materials management processes
- Develop new skills for sustainability

Asset **Management** Planning

Business Opportunity

If LANSCE and SIGMA are unable to deliver on their national security science missions, then customer confidence and funding will decline, and the complex will lose unique capabilities.

The convergence of aging obsolete equipment, increasing demands, and insufficient resources to manage organizational risks are creating a greater need for Asset Management System maturity.

eruditio®

Partnered with Eruditio to facilitate the improvement process and train our staff for sustainability.

Timeline

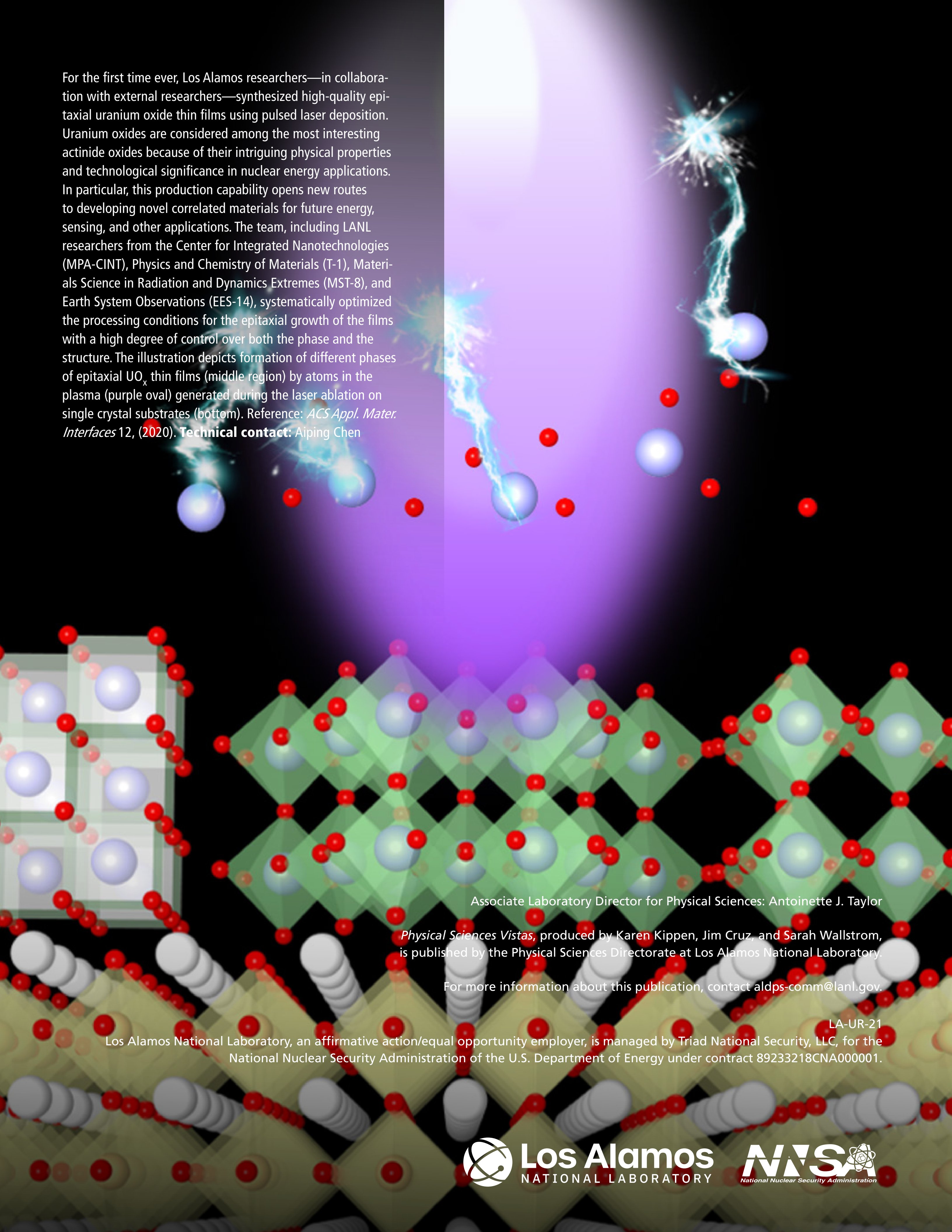
Assessment
56 LANL staff interviews

Analysis & Design
2 Focused Improvement Teams
Engineering Projects to Develop:
- Equipment Maintenance Plans
- Spare Parts Plans
- Risk Management Plans
- Lifecycle Management Plans

Pilot Implementation
Focused on Critical Systems

Focused Improvement Teams (FIT)

- **40 Cross-functional Team Members,**
- **Business Process Re-engineering Approach, plus**
- **Short-interval Engineering Projects.**



For the first time ever, Los Alamos researchers—in collaboration with external researchers—synthesized high-quality epitaxial uranium oxide thin films using pulsed laser deposition. Uranium oxides are considered among the most interesting actinide oxides because of their intriguing physical properties and technological significance in nuclear energy applications. In particular, this production capability opens new routes to developing novel correlated materials for future energy, sensing, and other applications. The team, including LANL researchers from the Center for Integrated Nanotechnologies (MPA-CINT), Physics and Chemistry of Materials (T-1), Materials Science in Radiation and Dynamics Extremes (MST-8), and Earth System Observations (EES-14), systematically optimized the processing conditions for the epitaxial growth of the films with a high degree of control over both the phase and the structure. The illustration depicts formation of different phases of epitaxial UO_x thin films (middle region) by atoms in the plasma (purple oval) generated during the laser ablation on single crystal substrates (bottom). Reference: *ACS Appl. Mater. Interfaces* 12, (2020). **Technical contact:** Aiping Chen

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